Consumer and Corporate Affairs Canada | Consommation et Corporations Canada

123/43Q

(11) (A) No. 1 155 064

(45) ISSUED 831011

(52) CLASS 171-105

(51) INT. CL.[3] F02B 53/14

(19) (CA) **CANADIAN PATENT** (12)

(54) MULTICYCLE ROTARY ENGINE

(72) Dobrovolny, Frank J.,
Canada

(21) APPLICATION No. 365,053

(22) FILED 801119

No. OF CLAIMS 40

Canada

DISTRIBUTED BY THE PATENT OFFICE, OTTAWA.
CCA-274 (11-82)

MULTICYCLE ROTARY ENGINE

BACKGROUND OF THE INVENTION

This invention relates to new and useful improvements in multicycle rotary engines.

Many attempts have been made to provide rotary engines of one form or another all of which suffer from various disadvantages such as sealing difficulties, unbalanced forces, heavy centrifugal and centripetal forces, and reciprocating pistons of one form or the other.

SUMMARY OF THE INVENTION

The present invention overcomes these disadvantages by providing a compact rotary engine which eliminates the reciprocal piston assemblies common with most rotary engines. In accordance with the invention there is provided a multicycle rotary engine comprising in combination a substantially cylindrical hollow casing including spaced and parallel side plates and an annular wall extending around the side plates adjacent the peripheries thereof, a main drive shaft journalled for rotation axially through said casing from one side plate to the other, a block within said casing mounted upon said shaft for rotation therewith, a plurality of pivoting gate pistons pivoted adjacent one end thereof to said block for movement of the other end towards and away from said

shaft, a gate divider in said block between each pair of adjacent gate pistons, the distal ends of said gate pistons being in sealing relationship with one side of the divider as the distal ends of said gate pistons move towards and away from said shaft, an axially located stationary gear secured within said casing, connecting means operatively extending from each of said gate pistons to said stationary gear to move said distal ends of said gate pistons towards and away from said shaft as said block rotates with said shaft, and at least one intake port, exhaust port, and mixture firing means extending through said annular wall of said casing operatively connecting with the areas swept by said gate pistons as said block rotates, to provide in sequence, for each gate piston, an intake, a compression, an expansion and an exhaust stroke.

Another advantage of the invention is to provide a device of the character herewithin described in which the centrifugal and centripetal forces are reduced from conventional rotary engines.

Yet another advantage of the invention is to provide a device of the character herewithin described which, as the power stroke occurs, the pressure is first generated at one end of the gate piston and then increases towards the other distal end as the gate piston moves towards the central

axis of the engine in the power stroke.

Still another advantage of the invention is to provide a device of the character herewithin described which is simple in construction, economical in manufacture and otherwise well suited to the purpose for which it is designed.

With the foregoing in view, and other advantages as will become apparent to those skilled in the art to which this invention relates as this specification proceeds, the invention is herein described by reference to the accompanying drawings forming a part hereof, which includes a descritpion of the preferred typical embodiment of the principles of the present invention, in which:

DESCRIPTION OF THE DRAWINGS

Figure 1 is a front elevation of the engine with one side removed, showing one embodiment with the gate pistons being in the outermost position.

Figure 2 is a view similar to Figure 1 but showing the gate pistons moved through approximately 22 1/2° from Figure 1.

Figure 3 is a view similar to Figure 1 but showing the gate pistons moved through approximately 45° with reference to Figure 1.

Figure 4 is a view similar to Figure 1 but showing

the pistons on the return stroke having moved through approximately 67 1/2° with reference to Figure 1.

Figure 5 is a view similar to Figure 1 but showing the preferred embodiment of the stationary gear assembly and with the direction of movement of the gate pistons reversed with reference to Figure 1.

Figure 6 is a vertical cross sectional view of Figure 1.

Figure 7 is an enlarged fragmentary view of part of Figure 5 showing one of the gate pistons moving on the expansion stroke.

Figure 8 is an end view of one of the connecting rod assemblies with the gate piston cross sectioned.

Figure 9 is an enlarged fragmentary side view of one of the gate pistons in a portion of the block and showing the various seals for the block and the gate piston.

Figure 10 is a top plan view of Figure 10.

Figure 11 is a plan view of the gate piston seal per se.

Figure 12 is a schematic diagram showing the movement of the crank journals relative to the fixed annular sun gear of Figures 1 to 4.

Figure 13 is a view similar to Figure 13 but showing the tracking of the crank journals with reference to the

fixed sun gear of Figure 5.

In the drawings like characters of reference indicate corresponding parts in the different figures.

DETAILED DESCRIPTION

Proceeding therefore to describe the invention in detail, reference should first be made to Figures 1 to 4 inclusive, together with Figure 6.

A substantially cylindrical casing is provided collectively designated 20 and comprises a pair of spaced and parallel cylindrical side plates 21 and 22 maintained in the desired relationship by an annular wall 23 secured therebetween adjacent the peripheries thereof, by nut and bolt assemblies 24.

Bearings 25 are provided axially through the end walls 21 and 22 of the casing, to support for rotation a main drive shaft 26, the ends of which extend beyond the confines of the casing as clearly shown in Figure 6.

A stationary sun gear 27 is secured to the inside of the side wall 22 of the casing by means of bolts 28 coaxially with the shaft 26, said gear in Figures 1 to 4 comprising an annulus gear having gear teeth 29 formed on the inner surface thereof as clearly shown.

A substantially cylindrical block collectively designated 30 rotates within the casing 20 and is secured as by

splines 31, to the shaft 26 and in the drawings, this block together with components secured thereto as will hereinafter be described, rotates in the direction as indicated by arrow 32.

This block is preferably cast with one end wall 33 and annular wall 34 cast in one piece and side plate 33A secured by bolts 33B to gate dividers 40, which will hereinafter be described.

The block is provided with a plurality of substantially rectangular openings 35 through the annular wall 34 as shown in Figure 10, said openings being equidistantly spaced around the periphery of the wall 34. A substantially rectangular seal 36 engages within a similar shaped groove 37 within the outer surface 38 of the peripheral wall 34 and surrounds the boundaries of the openings 35. This seal may be formed from any desired material either plastic, metal or other substance and bears against the inner surface 39 of the annular wall 23 of the casing thus providing a seal around the apertures 35.

A plurality of gate or block dividers collectively designated 40 extend inwardly from the annular wall 34 of the block at equidistantly spaced positions, there being one divider for each aperture 35 formed through the wall 34 and extending from adjacent the trailing end 41 of each aperture

35. When viewed in cross section as illustrated in Figures 1 to 4, for example, these dividers include an arcuately cur-

ved rear side or surface 42 and a substantially semi-circular curved front surface 43 as clearly illustrated in Figures 1 to 4.

The annular wall 34 trails rearwardly from these dividers to the adjacent aperture 35.

A plurality of gate pistons are provided collectively designated 44, there being one gate piston for each aperture 35, extending between adjacent dividers 40.

Each gate piston is substantially rectangular when viewed in plan as shown in Figure 10 and is arcuately curved when viewed in side elevation as shown in Figures 1 to 4 for example. Each gate piston includes an enlarged trailing end 45, the rear curvature 46 of which is similar to the curve 43 on the front side of the divider 40. Each gate piston is pivoted between the side walls 33 of the block upon a pivot pin and bearing 47 so that the leading end 48 of the gate piston may move inwardly or away relative to the drive shaft 26 in a pivoting action as clearly shown in Figures 1 to 4.

The depth of the gate piston 44 gradually decreases from the trailing end 46 towards the leading end 48 and the outer surface 49 is arcuately curved and is provided with a transverse step 50 intermediate the ends thereof which coincides with the front or leading end 41A of the aperture 35 so that when the gate piston is in the outermost position

illustrated for example in Figure 1, the rear curved surface 49A is adjacent the inner curved surface 39 of the annular wall 23 of the casing and the front curved surface 49B is adjacent the inner curved surface 51 of the block with the curvatures 49A being similar to the curvature of the wall 23 and the curvature 49B being similar to the curvature 51 of the block.

One or more substantially rectangular compression seals 52 (Figure 11) with curved front and rear ends 53, engage within corresponding grooves around the four sides of the gate pistons 44 adjacent the outer surfaces 49 thereof with the front ends 53 of the seals being in sealing engagement with the trailing curved surface 42 of the dividers 40 and the rear ends of the seals being in sealing relationship with the leading curved surface 43 of the dividers as the gate pistons pivot around pin 47. The longitudinally extending sides of the seals 52 are in sealing engagement with the side plates 33 of the block.

Means are provided operatively connecting the gate pistons with the stationary gear 27, said means taking the form of a crank shaft collectively designated 54 for each gate piston. This crank shaft includes a mounting pin 55 upon which is journalled for rotation a planetary gear 56 engageable with the teeth 29 of the stationary gear 27.

Each crank shaft is provided with a throw or crank pin 57 which if offset from the mounting pin 55 by means of webs 58 (see Figure 6), and a connecting rod 59 is journalled upon the crank 57 by the bottom end 60 thereof.

The outer end of the connecting rod 59 is provided with a wrist pin 61 extending transversely thereacross, said wrist pin bearingly engaging wrist pin bearings 62 spanning the gate piston 44 intermediate the front and rear ends thereof as clearly illustrated.

Diametrically opposed intake and inlet ports 63 are formed through the wall 23 of the casing and are connected to a source of mixture supplied by a carburetor or the like (not illustrated). Alternatively of course air may be drawn in through these ports with diesel injectors (not illustrated) also being provided.

Also provided through the wall 23 of the casing is a pair of exhaust ports 64 which vent to atmosphere either directly or through an exhaust system (not illustrated). Firming means such as spark plugs 65 are screw threadably engageable through the wall 23 of the casing and in the present embodiment, two such plugs are provided diametrically opposite one another and being situated between the inlet and exhaust ports. These lead to small combustion chambers

66 formed in the wall 23 which communicate via passages 67, into the interior of the casing.

In the present embodiment, four gate pistons 44 are provided connected via the connecting rod assemblies 59 to the stationary gear 27.

As the block is rotated in the direction of arrow 32, the engagement of the planetary gears 56 with the annular gear 27 causes the crank pins to rotate in the direction of arrow 68 so that the crank pins describe arcs as illustrated in Figure 12.

In operation of this embodiment, reference should first be made to Figure 1 which shows the gate pistons in the outermost positions equivalent to top dead center and with the crank pins in the position illustrated.

Gate pistons B and D are approaching the firing position with the gas mixture being fully compressed between the gate pistons and the annular wall portions 23 and 39 with the apertures 35 of the wall 34 just approaching the firing chambers 66.

As the mixture fires in the two chambers 66, the expansion thereof reacts between the annular wall 23 and the surface 49A of the two gate pistons B and D forcing them towards the shaft 26 pivoting on pins 47. Flame propogation then spreads the flame travel towards the front of

the gate pistons so that it reacts between the inner surface of the wall portion 34 of the block, particularly the portions 51 thereof thus giving additional impetus to the movement of the gate pistons towards the shaft 26 with the leverage increasing as the pressure moves further from the pivot 47.

This causes the crank shafts to rotate in the direction of arrows 68 and in Figure 2, the gate pistons are shown approximately 22 1/2° removed from the position in Figure 1.

Gate pistons A and C are moved by the same amount by the engagement of the planetary gears 56 with the stationary gear 27 and these two pistons have commenced their intake stroke drawing mixture in through the inlet ports 63.

Figure 3 shows the gate pistons B and D in their fully inward position, these positions being the equivalent of bottom dead center of the expansion stroke and it will be observed that the leading end of the aperture 41 within the wall 34 is just clearing the exhaust ports 64 so that as the block rotates further, the exhaust stroke commences. In Figure 3, the gate pistons have moved approximately 45° relative to Figure 1.

Further rotation to the position shown in Figure 4, causes the gate pistons B and D to start moving outwardly

relative to the shaft 26 thus exhausting gases rearwardly through the exhaust ports 64 as indicated by arrows 69. In Figure 4, the gate pistons have moved through approximately 67 1/2° relative to Figure 1.

In this position, gate pistons A and C are moving outwardly on the compression stroke approaching the position of the gate pistons B and D of Figure 1.

It will therefore be observed, in this embodiment, that any two opposing gate pistons move through a complete cycle of intake compression expansion and exhaust in 180° rotation of the block so that each gate piston completes two cycles in one revolution of the block. In other words with four gate pistons as shown, there are eight firing strokes per revolution of the block.

The relative positions of the crank shafts are also shown in Figures 1, 2, 3 and 4 due to the engagement of the planetary gears with the stationary annular gear 27.

Reference to Figures 8 and 10 show a pair of elongated depressions 70 formed in the outer surface 49A of the gate pistons which act as swirl chambers for the mixture and give optimum flame propagation.

Figure 5 is similar to Figure 1 except that the stationary sun gear, in this embodiment, takes the form of a gear 71' with the planetary gears 72 engaging the gear teeth

73 formed around the outer periphery of the sun gear. In this embodiment thrust bearings 74 are required to hold the planetary gears into engagement with the sun gear 71'.

Figure 13 shows the track of the crank journals 57, for the embodiment illustrated in Figure 5 as compared to the similar tracking shown in Figure 12 for the internal stationary gear 27.

Figures 5 and 8 shown an embodiment which also travels counterclockwise but with the gate pistons reversed in position relative to those of the previous drawings.

The operation of the engine is the same as hereinbefore described except that the gate pistons are in a trailing relationship relative to the direction of rotation and compared to those of the previous embodiment.

Similar reference characters have been given in Figures 5 and 8 except for the moving parts which have been provided with primed numbers.

The internal annulus gear 27 has the following advantages over the sun gear 73.

a) The planetary gears rotate 135° per stroke.

b) The journals of the planetary gear are at a preferable position at top dead center for the expansion stroke due to the reverse rotation of the crank shafts.

c) Quick stroking is achieved with the fixed annulus as shown in the tracking diagram of Figure 13.

The use of the free wheeling sun gear can be optimized for balancing the torque to the planetary gears during the expansion stroke. The fixed sun gear on the other hand, has several advantages over the annulus gear.

These include the fact that the planetary gear rotates 225° per stroke relative to the fixed sun gear so that higher pressures may be obtained during the expansion strokes.

The planetary gears with the journals are shown at a preferable position at top dead center for the expansion stroke and slower piston seal speeds are obtained leading to efficient exhaust and intake strokes.

It will of course be appreciated that various configurations can be used with anywhere from 2 to 10 or more gate pistons and 2 to 20 or more cycles.

The invention utilizes the virtues of the reciprocating turbine radial rotary and jet engines and is a mechanical and cyclical balance.

The gate pistons are free of high forces which are often found in rotary engines and it will be observed that the gates move in opposite direction to the exhaust stream.

The expansion stroke has a double effect. Firstly,

the pressures react between the surface of the gate piston and the wall of the block and casing and secondly, they react on the front or leading edge of the divider for a turbine-type force from the expanding gases which act in the direction of rotation.

The device is of course low on centrifugal and centripetal forces and is readily adaptable for supercharging or two cycle use by ports and seals through the central portion and dividers due to the simultaneous action of the gates.

As well as using a fixed sun gear or an annulus gear, a planetary gear chain can be utilized, the choice being dependent upon the application of the engine.

It will also be observed that the stroke is increasing in length from the journal centers to the oscillating pin, to over double the length of stroke at the leading edge of the gate pistons.

The present embodiments illustrated include water cooling via passages 71 formed in the outer casing but of course air cooling can readily be incorporated by means of fins (not illustrated) if desired.

It will be appreciated that although Figures 1 - 4 show an engine which rotates in the direction of arrow 32, i.e. counterclockwise with the free ends of the gate pistons

leading and with an internally toothed annular sun gear 27, this arrangement and direction of rotation can be used equally well with the externally toothed sun gear 71' and in fact this is the preferred embodiment.

Also, the embodiment shown in Figures 5 and 7 can be used with the gate pistons being situated as shown in Figures 1 to 4, i.e. with the free ends of the gate pistons leading.

It should also be noted that the arrangement of ports permits design flexibility in the position of the gate pistons relative to the effective top dead center and bottom dead center positions thereof and also the overlap between inlet and exhaust strokes. For example, Figure 5 illustrates an arrangement whereby the induction stroke begins with the crank throw at 22 1/2° before T.D.C. and the leading end of the block seal at the intake port. As the crank throw continues to rotate, the gate piston descends causing a suction as the leading end of the block seal advances past the port. The trailing end of the block seal passes the intake port when the crank throw rotates to 55° after B.D.C. to complete the induction stroke. The block is then rotated through the compression and expansion strokes whereupon the leading end of the block seal reaches the exhaust port and the crank throw is at 45° before B.D.C. to commence the exhaust stroke. The gate piston pivots outward expelling the exhaust gases and the leading end of the block seal advances to the intake port

as the crank throw rotates to 22 1/2° before T.D.C.

The overlap of intake and exhaust ports then begins as the block rotates 11 1/4° and the crankshaft rotates 45° during the overlap period. The leading end of the block seal advances into the intake port area while the trailing end of the block seal is closing the exhaust port. Further rotation of the crank throw then continues the intake stroke.

During the overlap period the momentum of the exhaust gases create a suction on the intake port and to initiate complete purging of the exhaust gases, while the late closing of the intake port is to take advantage of the momentum of the intake mixture.

The port timing can be readily altered to suit various applications or high performance speeds.

Since various modifications can be made in my invention as hereinabove described, and many apparently widely different embodiments of same made within the spirit and scope of of the claims without departing from such spirit and scope, it is intended that all matter contained in the accompanying specification shall be interpreted as illustrative only and not in a limiting sense.

WHAT I CLAIM AS MY INVENTION IS:

(1) A multicycle rotary engine comprising in combination a substantially cylindrical hollow casing including spaced and parallel side plates and an annular wall extending around the side plates adjacent the peripheries thereof, a main drive shaft journalled for rotation axially through said casing from one side plate to the other, a block within said casing mounted upon said shaft for rotation therewith, a plurality of pivoting gate pistons each pivoted adjacent one end thereof to said block for movement of the other end towards and away from said shaft, a gate divider in said block between each pair of adjacent gate pistons, the distal ends of said gates being in sealing relationship with one side of the divider as the distal ends of said gates move towards and away from said shaft, an axially located stationary sun gear secured within said casing, connecting means operatively extending from each of said gate pistons to said stationary sun gear to move said distal ends of said gate pistons towards and away from said shaft as said block rotates with said shaft, and at least one intake port, exhaust port, and mixture firing means extending through said annular wall of said casing operatively connecting with the areas swept by said gate pistons as said block rotates, to provide in sequence, for

each gate piston, an intake, a compression, an expansion and an exhaust stroke.

(2) The invention according to Claim 1 in which each of said gate pistons includes two firing sequences for each 360° of rotation of said block.

(3) The invention according to Claim 1 in which each of said gate pistons includes an enlarged one end pivotally attaching same to said block, a transverse pivot pin in said block upon which said gate is mounted for said pivotal movement, a curved outer surface on said gate piston, the radius of which is substantially similar to the radius of the inner surface of the annular wall of said casing, said gate divider including a curved front wall, said enlarged one end of said gate piston being curved with a radius similar to the radius of curvature of said front wall and at least one recess formed in the outer curved surface of said gate piston acting as a swirl chamber.

(4) The invention according to Claim 2 in which each of said gate pistons includes an enlarged one end pivotally attaching same to said block, a transverse pivot pin in said block upon which said gate is mounted for said pivotal movement, a curved outer surface on said gate piston, the radius of which is substantially similar to the radius of the inner surface of the annular wall of said

casing, said gate divider including a curved front wall, said enlarged one end of said gate piston being curved with a radius similar to the radius of curvature of said front wall and at least one recess formed in the outer curved surface of said gate piston acting as a swirl chamber.

(5) The invention according to Claim 3 which includes at least one seal assembly extending around the sides of said gate piston whereby said gate piston is in sealing relationship with said front curved wall of said gate divider, said rear curved wall of the next leading gate divider, and the sides of said block.

(6) The invention according to Claim 4 which includes at least one seal assembly extending around the sides of said gate piston whereby said gate piston is in sealing relationship with said front curved wall of said gate divider, said rear curved wall of the next leading gate divider, and the sides of said block.

(7) The invention according to Claim 1 in which said block includes a pair of substantially circular side walls, said gate dividers extending between said side walls towards the center of said side walls, and a curved trailing peripheral wall extending rearwardly from each of said gate dividers defining substantially rectangular openings through the peripheral wall of said block, and sealing means extend-

ing around the said rectangular apertures whereby the outer peripheral surface of said block around said apertures is in sealing relationship with the inner surface of the peripheral wall of said casing.

(8) The invention according to Claim 2 in which said block includes a pair of substantially circular side walls, said gate dividers extending between said side walls towards the center of said side walls, and a curved trailing peripheral wall extending rearwardly from each of said gate dividers defining substantially rectangular openings through the peripheral wall of said block, and sealing means extending around the said rectangular apertures whereby the outer peripheral surface of said block around said apertures is in sealing relationship with the inner surface of the peripheral wall of said casing.

(9) The invention according to Claim 3 in which said block includes a pair of substantially circular side walls, said gate dividers extending between said side walls towards the center of said side walls, and a curved trailing peripheral wall extending rearwardly from each of said gate dividers defining substantially rectangular openings through the peripheral wall of said block, and sealing means extending around the said rectangular apertures whereby the outer peripheral surface of said block around said apertures is

in sealing relationship with the inner surface of the peripheral wall of said casing.

(10) The invention according to Claim 4 in which said block includes a pair of substantially circular side walls, said gate dividers extending between said side walls towards the center of said side walls, and a curved trailing peripheral wall extending rearwardly from each of said gate dividers defining substantially rectangular openings through the peripheral wall of said block, and sealing means extending around the said rectangular apertures whereby the outer peripheral surface of said block around said apertures is in sealing relationship with the inner surface of the peripheral wall of said casing.

(11) The invention according to Claim 5 in which said block includes a pair of substantially circular side walls, said gate dividers extending between said side walls towards the center of said side walls, and a curved trailing peripheral wall extending rearwardly from each of said gate dividers defining substantially rectangular openings through the peripheral wall of said block, and sealing means extending around the said rectangular apertures whereby the outer peripheral surface of said block around said apertures is in sealing relationship with the inner surface of the peripheral wall of said casing.

(12) The invention according to Claim 6 in which said block includes a pair of substantially circular side walls, said gate dividers extending between said side walls towards the center of said side walls, and a curved trailing peripheral wall extending rearwardly from each of said gate dividers defining substantially rectangular openings through the peripheral wall of said block, and sealing means extending around the said rectangular apertures whereby the outer peripheral surface of said block around said apertures is in sealing relationship with the inner surface of the peripheral wall of said casing.

(13) The invention according to Claim 1 in which said connecting means includes a crank shaft for each gate piston, said crank shaft including a mounting pin and crank pin offset therefrom, a planetary gear mounted for rotation upon said mounting pin and engaging with said stationary sun gear, a connecting rod journalled for rotation by the bottom end thereof to said crank pin, and a wrist pin connected at the outer end of said connecting rod, operatively connecting same to said gate piston intermediate the ends of said gate piston.

(14) The invention according to Claim 2 in which said connecting means includes a crank shaft for each gate piston, said crank shaft including a mounting pin and crank

pin offset therefrom, a planetary gear mounted for rotation upon said mounting pin and engaging with said stationary sun gear, a connecting rod journalled for rotation by the bottom end thereof to said crank pin, and a wrist pin connected at the outer end of said connecting rod, operatively connecting same to said gate piston intermediate the ends of said gate piston.

(15) The invention according to Claim 3 in which said connecting means includes a crank shaft for each gate piston, said crank shaft including a mounting pin and crank pin offset therefrom, a planetary gear mounted for rotation upon said mounting pin and engaging with said stationary sun gear, a connecting rod journalled for rotation by the bottom end thereof to said crank pin, and a wrist pin connected at the outer end of said connecting rod, operatively connecting same to said gate piston intermediate the ends of said gate piston.

(16) The invention according to Claim 4 in which said connecting means includes a crank shaft for each gate piston, said crank shaft including a mounting pin and crank pin offset therefrom, a planetary gear mounted for rotation upon said mounting pin and engaging with said stationary sun gear, a connecting rod journalled for rotation by the bottom end thereof to said crank pin, and a wrist pin connected at

the outer end of said connecting rod, operatively connecting same to said gate piston intermediate the ends of said gate piston.

((17) The invention according to Claim 5 in which said connecting means includes a crank shaft for each gate piston, said crank shaft including a mounting pin and crank pin offset therefrom, a planetary gear mounted for rotation upon said mounting pin and engaging with said stationary sun gear, a connecting rod journalled for rotation by the bottom end thereof to said crank pin, and a wrist pin connected at the outer end of said connecting rod, operatively connecting same to said gate piston intermediate the ends of said gate piston.

(18) The invention according to Claim 6 in which said connecting means includes a crank shaft for each gate piston, said crank shaft including a mounting pin and crank pin offset therefrom, a planetary gear mounted for rotation upon said mounting pin and engaging with said stationary sun gear, a connecting rod journalled for rotation by the bottom end thereof to said crank pin, and a wrist pin connected at the outer end of said connecting rod, operatively connecting same to said gate piston intermediate the ends of said gate piston.

(19) The invention according to Claim 7 in which

said connecting means includes a crank shaft for each gate piston, said crank shaft including a mounting pin and crank pin offset therefrom, a planetary gear mounted for rotation upon said mounting pin and engaging with said stationary sun gear, a connecting rod journalled for rotation by the bottom end thereof to said crank pin, and a wrist pin connected at the outer end of said connecting rod, operatively connecting same to said gate piston intermediate the ends of said gate piston.

(20) The invention according to Claim 8 in which said connecting means includes a crank shaft for each gate piston, said crank shaft including a mounting pin and crank pin offset therefrom, a planetary gear mounted for rotation upon said mounting pin and engaging with said stationary sun gear, a connecting rod journalled for rotation by the bottom end thereof to said crank pin, and a wrist pin connected at the outer end of said connecting rod, operatively connecting same to said gate piston intermediate the ends of said gate piston.

(21) The invention according to Claim 9 in which said connecting means includes a crank shaft for each gate piston, said crank shaft including a mounting pin and crank pin offset therefrom, a planetary gear mounted for rotation upon said mounting pin and engaging with said stationary sun

gear, a connecting rod journalled for rotation by the bottom end thereof to said crank pin, and a wrist pin connected at the outer end of said connecting rod, operatively connecting same to said gate piston intermediate the ends of said gate piston.

(22) The invention according to Claim 10 in which said connecting means includes a crank shaft for each gate piston, said crank shaft including a mounting pin and crank pin offset therefrom, a planetary gear mounted for rotation upon said mounting pin and engaging with said stationary sun gear, a connecting rod journalled for rotation by the bottom end thereof to said crank pin, and a wrist pin connected at the outer end of said connecting rod, operatively connecting same to said gate piston intermediate the ends of said gate piston.

(23) The invention according to Claim 11 in which said connecting means includes a crank shaft for each gate piston, said crank shaft including a mounting pin and crank pin offset therefrom, a planetary gear mounted for rotation upon said mounting pin and engaging with said stationary sun gear, a connecting rod journalled for rotation by the bottom end thereof to said crank pin, and a wrist pin connected at the outer end of said connecting rod, operatively connecting same to said gate piston intermediate the ends of said gate

piston.

(24) The invention according to Claim 12 in which said connecting means includes a crank shaft for each gate piston, said crank shaft including a mounting pin and crank pin offset therefrom, a planetary gear mounted for rotation upon said mounting pin and engaging with said stationary sun gear, a connecting rod journalled for rotation by the bottom end thereof to said crank pin, and a wrist pin connected at the outer end of said connecting rod, operatively connecting same to said gate piston intermediate the ends of said gate piston.

(25) The invention according to Claims 1, 2 or 3 in which said stationary sun gear is in the form of an internally toothed annular gear.

(26) The invention according to Claims 4, 5 or 6 in which said stationary sun gear is in the form of an internally toothed annular gear.

(27) The invention according to Claims 7, 8 or 9 in which said stationary sun gear is in the form of an internally toothed annular gear.

(28) The invention according to Claims 10, 11 or 12 in which said stationary sun gear is in the form of an internally toothed annular gear.

(29) The invention according to Claims 13, 14 or

15 in which said stationary sun gear is in the form of an internally toothed annular gear.

(30) The invention according to Claims 16, 17 or 18 in which said stationary sun gear is in the form of an internally toothed annular gear.

(31) The invention according to Claims 19, 20 or 21 in which said stationary sun gear is in the form of an internally toothed annular gear.

(32) The invention according to Claims 22, 23 or 24 in which said stationary sun gear is in the form of an internally toothed annular gear.

(33) The invention according to Claims 1, 2 or 3 in which said stationary sun gear is an externally toothed annular gear.

(34) The invention according to Claims 4, 5 or 6 in which said stationary sun gear is an externally toothed annular gear.

(35) The invention according to Claims 7, 8 or 9 in which said stationary sun gear is an externally toothed annular gear.

(36) The invention according to Claims 10, 11 or 12 in which said stationary sun gear is an externally toothed annular gear.

(37) The invention according to Claims 13, 14 or

in which said stationary sun gear is an externally toothed annular gear.

(38) The invention according to Claims 16, 17 or 18 in which said stationary sun gear is an externally toothed annular gear.

(39) The invention according to Claims 19, 20 or 21 in which said stationary sun gear is an externally toothed annular gear.

(40) The invention according to Claims 22, 23 or 24 in which said stationary sun gear is an externally toothed annular gear.

ADE, KENT & ASSOCIATES

402 - 211 Portage Avenue,
Winnipeg, Manitoba
R3B 2A2

MULTICYCLE ROTARY ENGINE

ABSTRACT OF THE DISCLOSURE

A rotating block is secured to a central shaft and rotates within an annular casing. A stationary sun gear is secured to the casing coaxially with the shaft and planetary gears secured to the mounting shafts of a plurality of crank shafts, engage the sun gear. Each crank shaft has a throw portion upon which a bottom end bearing of a connecting rod is mounted and each connecting rod has wrist pin at the outer end thereof operatively connected to a gate-type piston intermediate the ends of the piston which in turn is pivoted to the rotating block adjacent one end thereof and in which the distal end of the gate piston pivots inwardly and outwardly with the distal end being in sealing engagement with an arcuately curved block divider. As the block rotates with the gates, connecting rods and crank shaft, the engagement of planetary gears with the sun gear moves the gates towards and away from the center shaft, pivoting on the pivotal mounting of the gates to the block. The gates move past intake ports as they open up from the periphery of the block and compress the mixture as they move towards the periphery of the block. The compressed mixture is fired by a spark plug which drives the gates open again and in the next movement towards the periphery of the block, the spent gases are ex-

hausted. The entire cycle of any one gate takes place through 180° of rotation of the block so that with four gates, for example, and diametrically opposing inlet and outlet ports and spark plugs, there are eight power strokes per revolution of the block. The necessary seals are provided between moving surfaces.

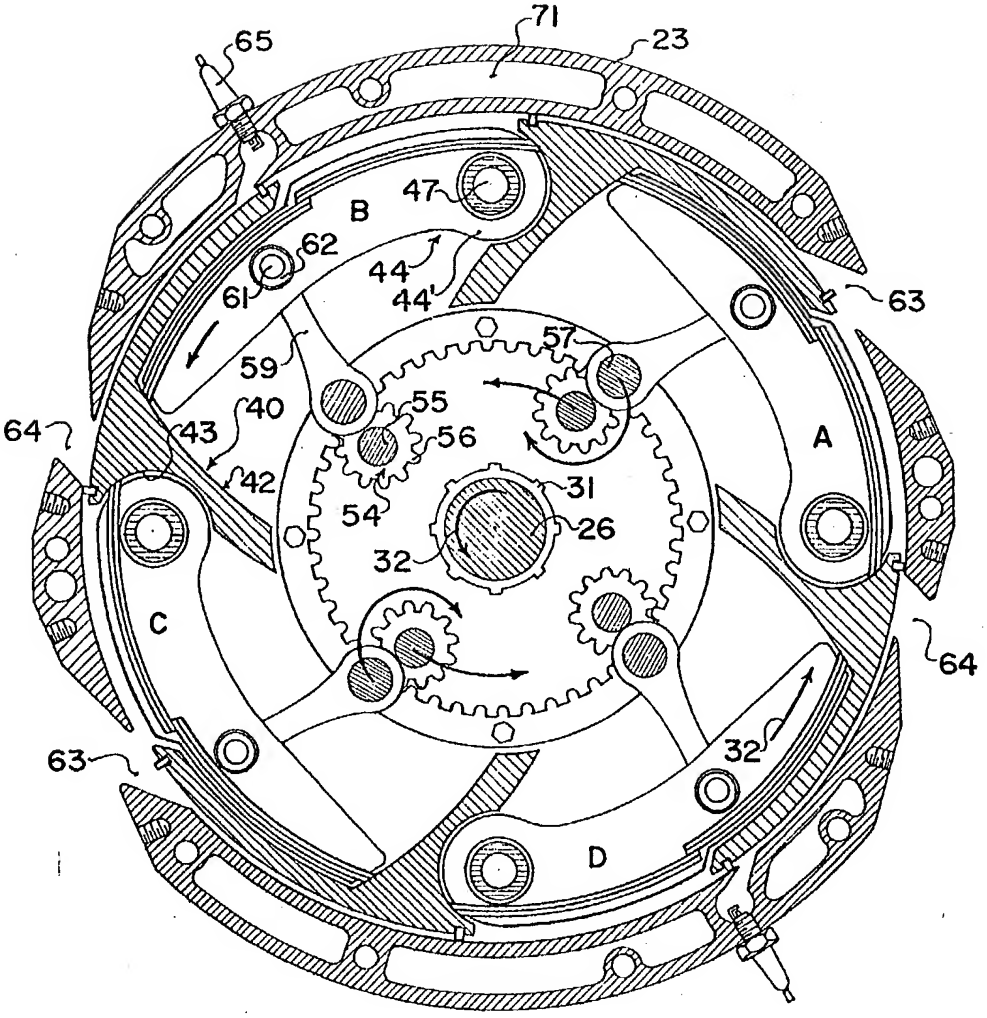

FIG. 1

Inventor: FRANK JOSEPH DOBROVOLNY

By: Ade, Kent & Associates

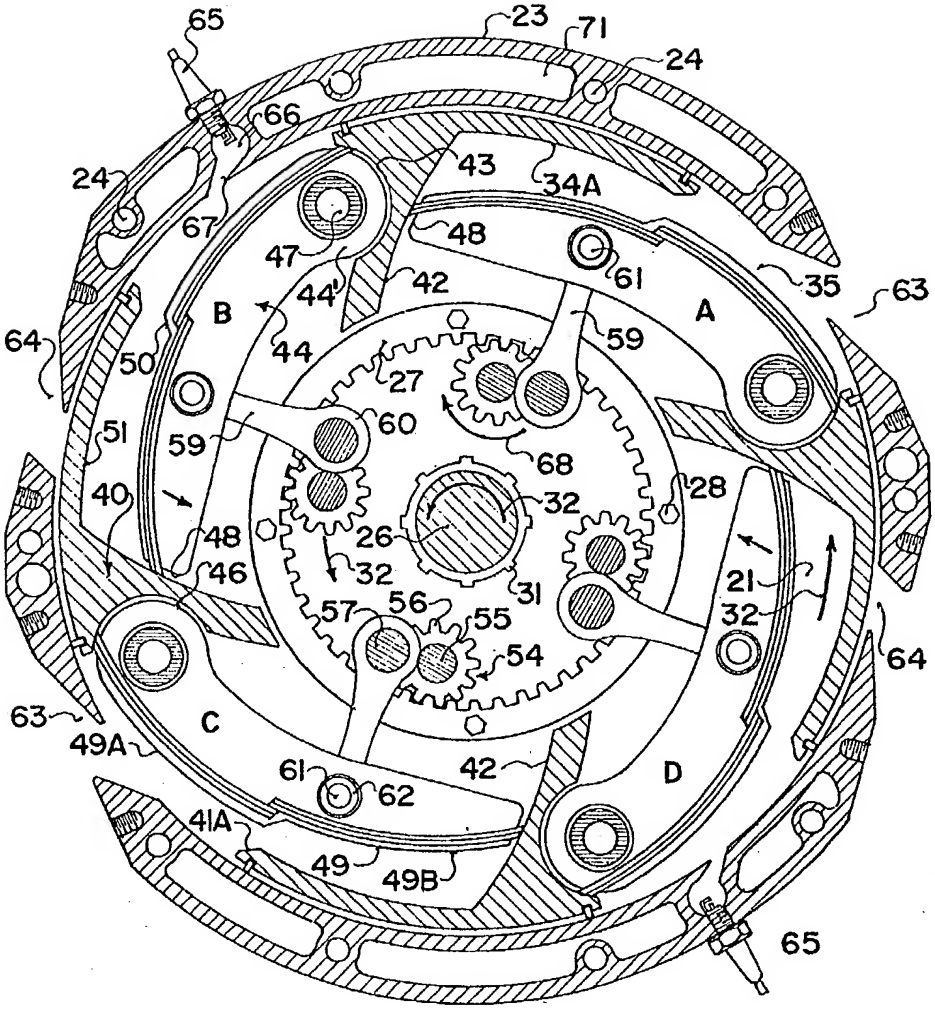

FIG. 2

Inventor: FRANK JOSEPH DOBROVOLNY

By: Ade, Kent, Associates

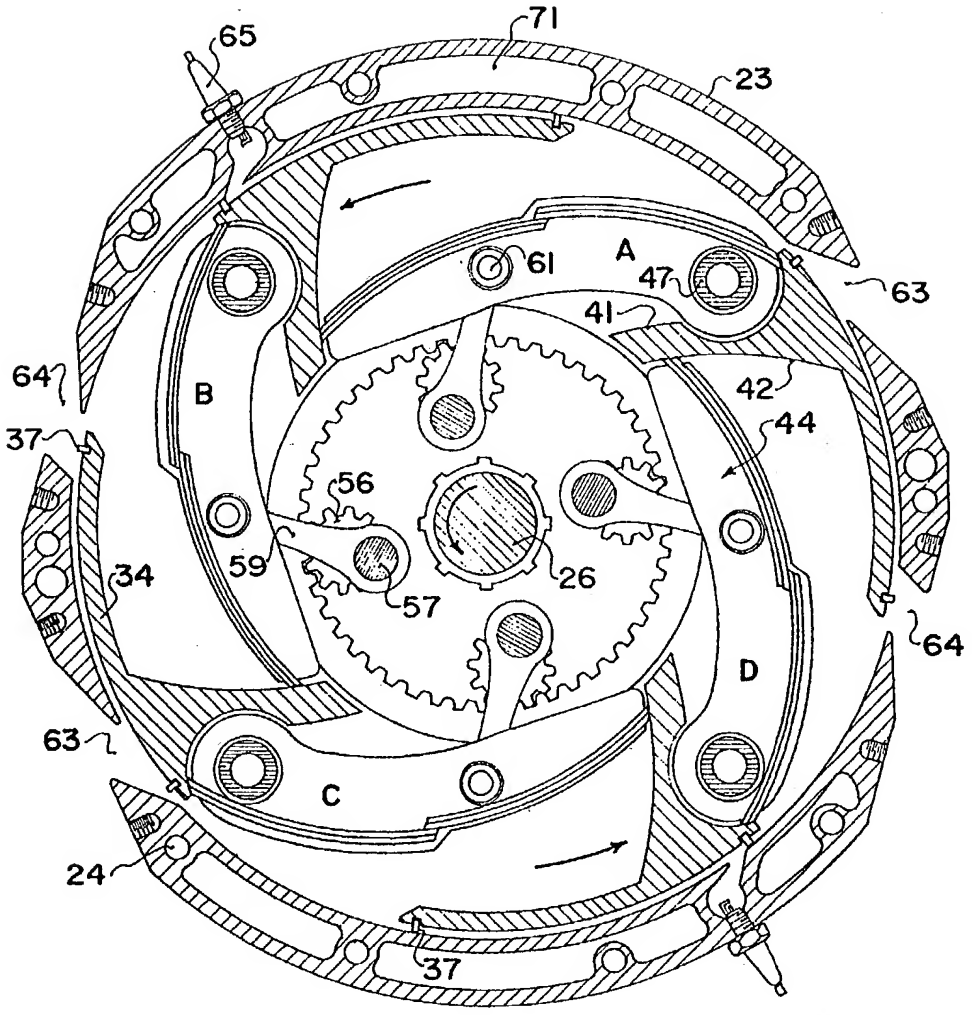

FIG. 3

Inventor: FRANK JOSEPH DOBROVOLNY

By: Ade, Kent, Associates

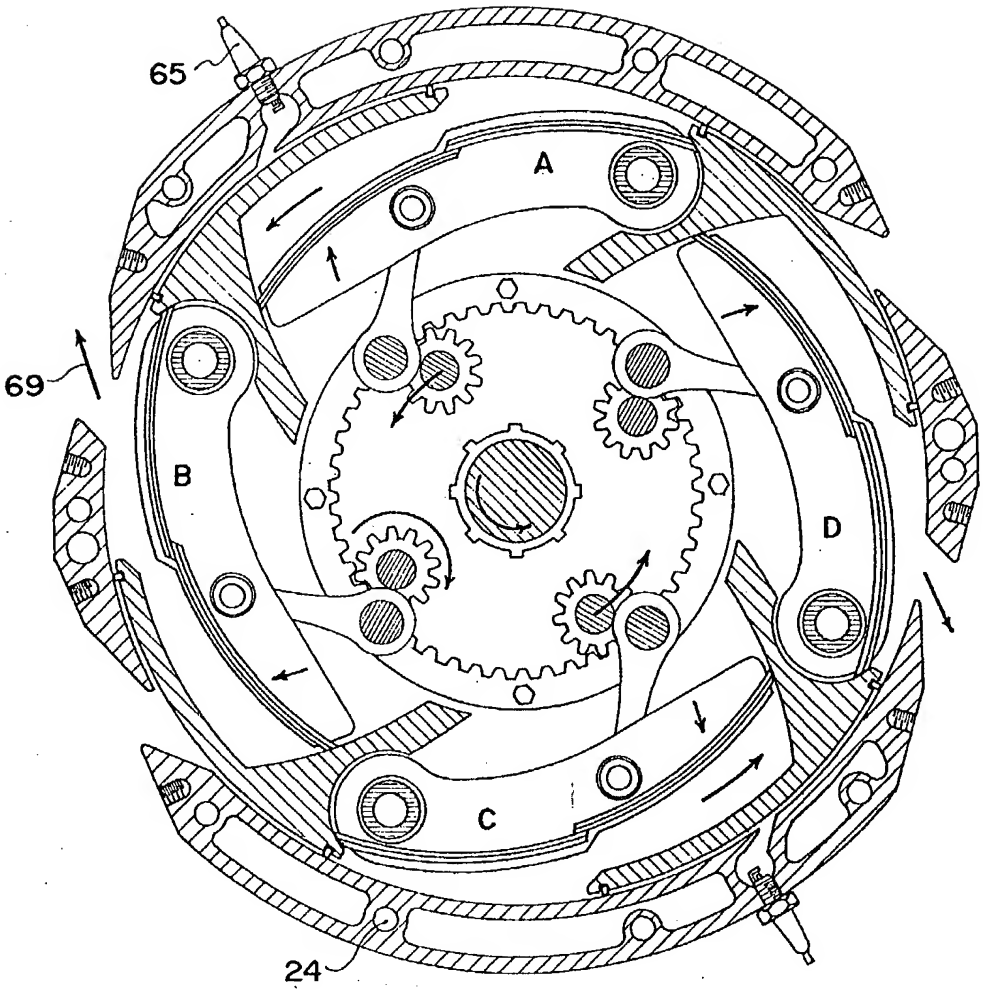

FIG. 4

Inventor: FRANK JOSEPH DOBROVOLNY
By: Ade, Kent, Associates

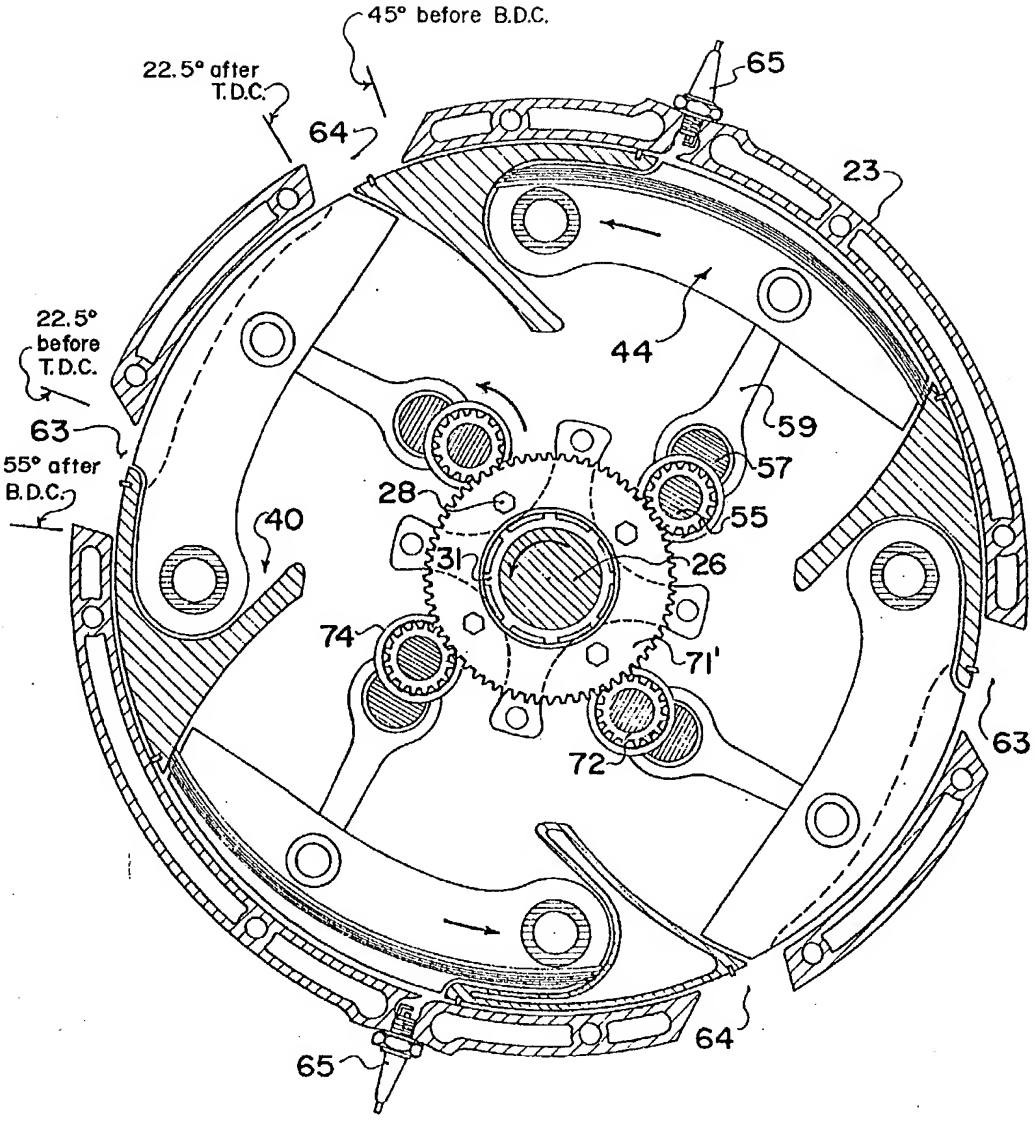

FIG. 5

Inventor: FRANK JOSEPH DOBROVOLNY

By: Ade, Kent & Associates

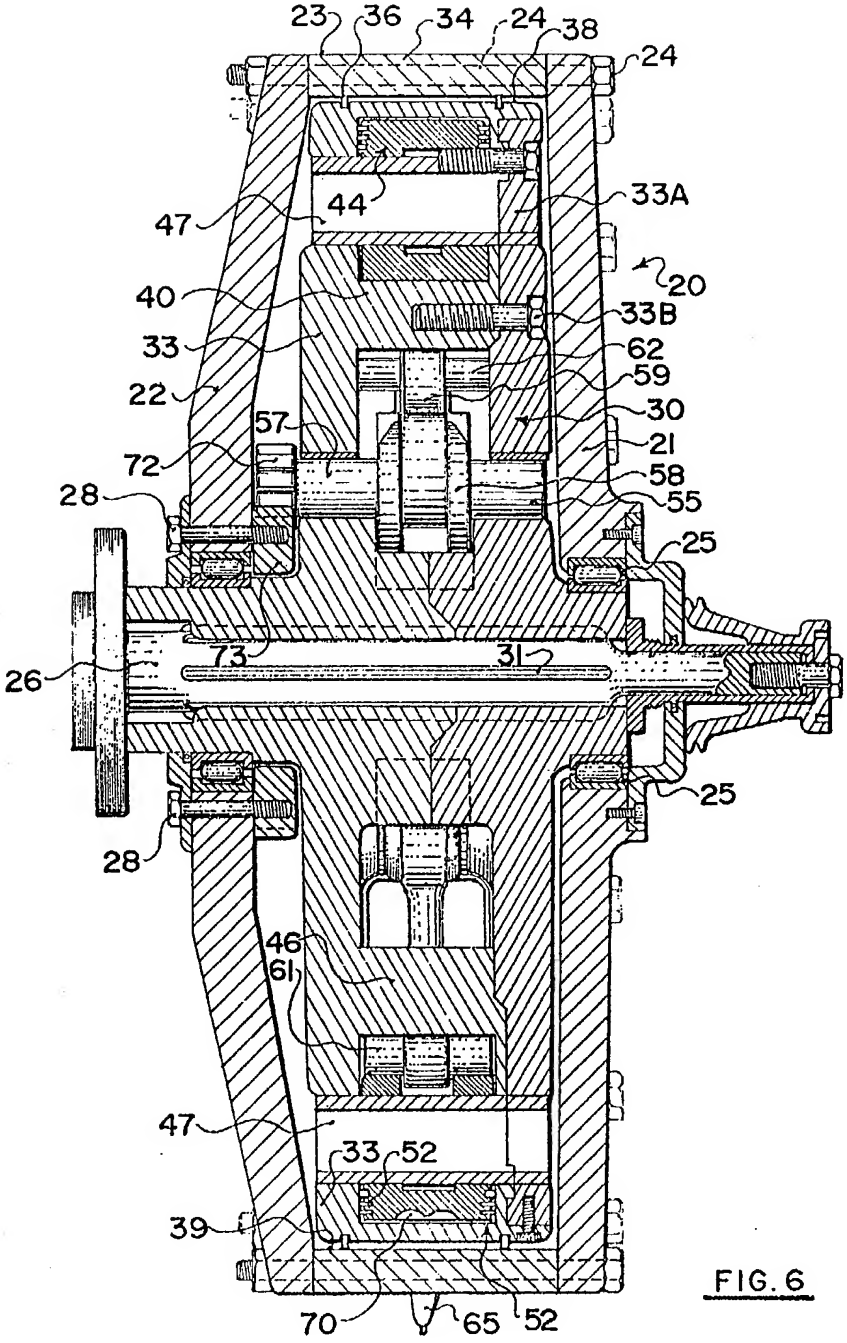

FIG. 6

Inventor: FRANK JOSEPH DOBROVOLNY

By: Ade, Kent, Associates

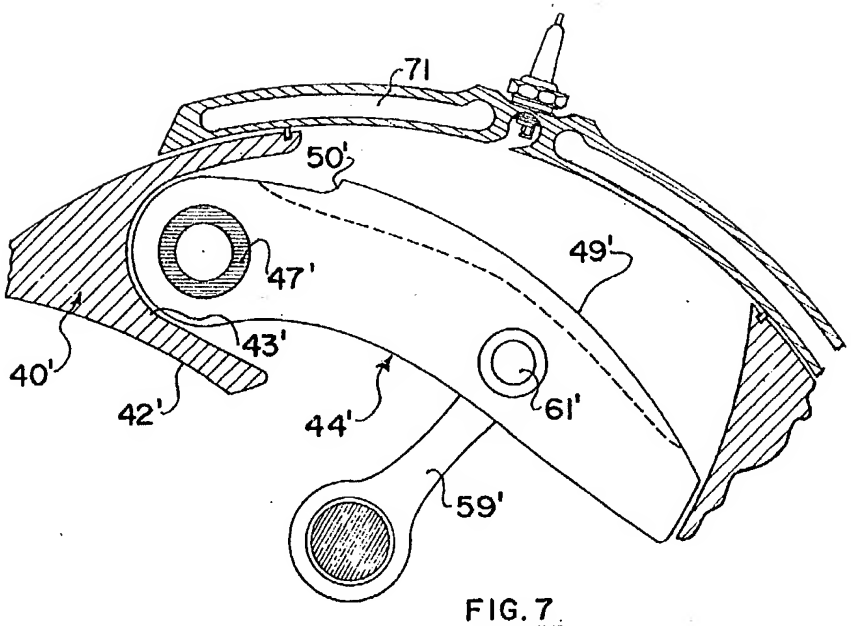

FIG. 7

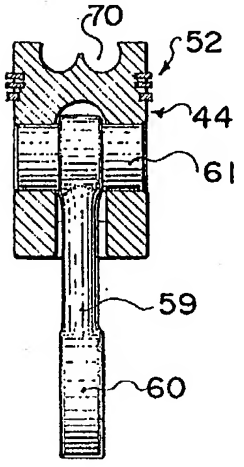

FIG. 8

Inventor: FRANK JOSEPH DOBROVOLNY
By: Ade, Kent & Associates

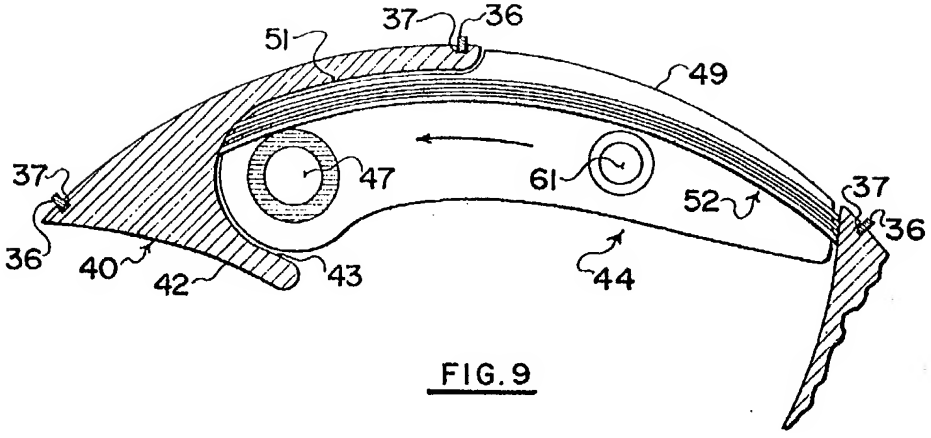

FIG. 9

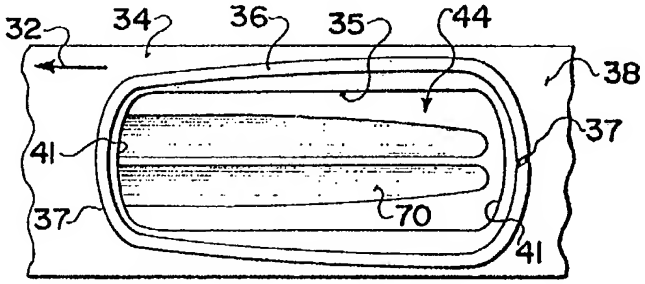

FIG. 10

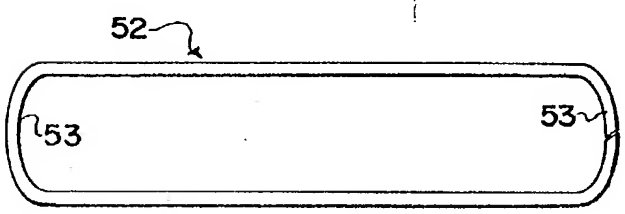

FIG. 11

Inventor: FRANK JOSEPH DOBROVOLNY

By: Ade, Kent, Associates

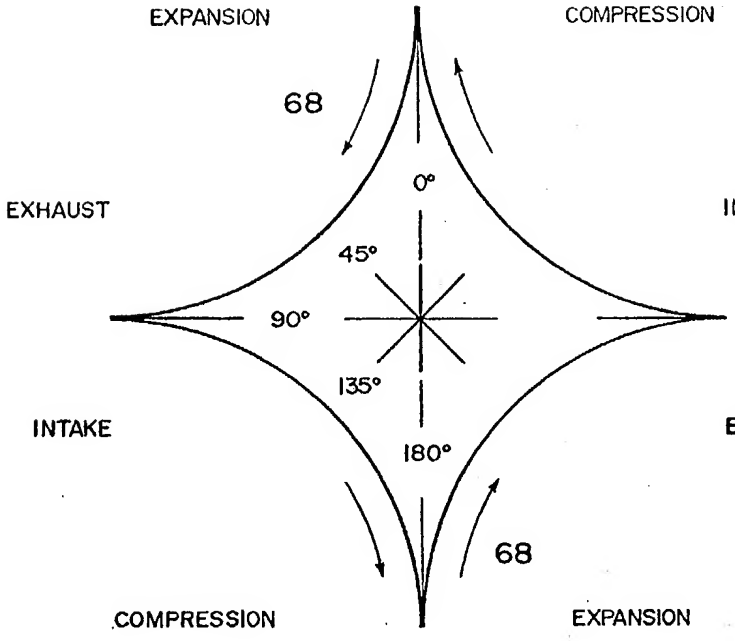

FIG. 12

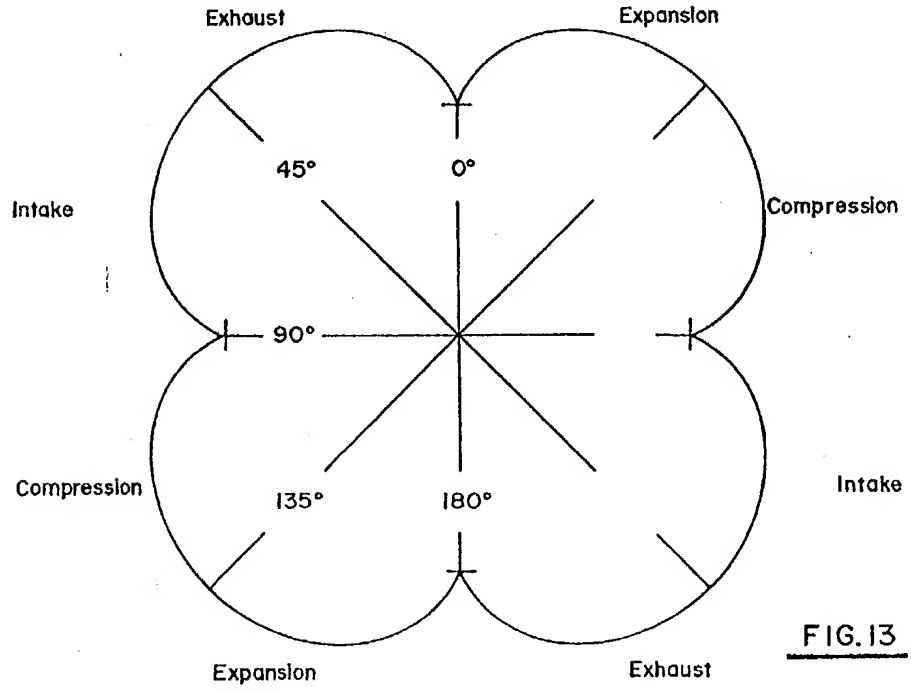

FIG. 13

Inventor: FRANK JOSEPH DOBROVOLNY

By: Ade, Kent & Associates